Positional Accuracy in Smart-Phones and its Effect on LBS Applications

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Abstract: **Location-based services (LBS) highly rely on the location of the mobile user in order to provide the service tailored to that location. This location is calculated differently depending on the technology available in the used mobile device. No matter which technology is used, the location will never be calculated 100% correctly; instead there will always be a margin of error generated during the calculation, which is referred to as positional accuracy. This research has reviewed the eight most common positioning technologies available in the major current smart-phones and assessed their positional accuracy with respect to its usage by LBS applications. Given the vast majority of these applications, this research classified them into thirteen categories, and these categories were also classified depending on their level criticality as low, medium, or high critical, and whether they function indoor or outdoor. The accuracies of different positioning technologies are compared to these two criteria. Low critical outdoor and high critical indoor applications were found technologically covered; high and medium critical outdoor ones weren't fully resolved. Finally three potential solutions are suggested to be implemented in future smartphones to resolve this technological gap: Real-Time Kinematics Global Positioning System (RTK GPS), terrestrial transmitters, and combination of Wireless Sensors Network and Radio Frequency Identification (WSN-RFID).**

Index Terms **— Accuracy, Location-Based Service, Positioning Technology, Wireless Communication**

I. Introduction

Location-based services (LBS) highly rely on the location of the mobile user in order to provide the service tailored to that location. This location is calculated differently depending on the technology available in the used mobile device. No matter which technology is used, the location will never be calculated/estimated 100%; there will always be a margin of error generated during the collection and computation. This error is estimated and referred to as positional accuracy.

The aim of this research is to review the latest position calculation technologies available in the major current smart-phones, and to assess their positional accuracy to the most common types of LBS applications in order to inherits effect on the results of these applications.

II. Methodology

In today's smartphones, there are eight different technologies available for positioning: Global Positioning System (GPS) providing outdoor positioning with an accuracy of 5-10 meters; Assisted GPS combining Wi-Fi signals with GPS; Synthetic GPS based on predictive algorithm instead of actual measurements; Cell-ID providing an accuracy of several hundreds of meters based on mobile network coverage; Wi-Fi providing an accuracy of 30-50 meters based on wireless hotspot network; Inertial sensors functioning based on the motion of the device; Barometer providing altitude indoor and outdoor; and Bluetooth beacons providing indoor positioning with an accuracy of 10cm based on a network of Bluetooth [1].

In this study, a survey was made on 40 major LBS applications available on different mobile platforms, such as Android, iOS, Blackberry OS, Symbian OS, and Windows Phone, based on these platforms applications download services (Google Play, iTunes, etc). These application were classified into thirteen categories depending on their functionality, and these categories were classified depending on their level of criticality as follow: Low Critical (Weather, Travel/Tourism, Place Discovery, Gaming, Social Media, and Sport/Outdoor), Medium Critical (Commerce / Business, Tracking, and Car Pooling), and High Critical (Health/Fitness, Emergency, Hazards, and Turn-by-Turn Navigation). The level of criticality was assessed on the causality/effect of the application result if provided a low-accurate of wrong location to be based on. Next these categories were assigned the location of their operation (indoor/outdoor), and the range of minimum allowed accuracy (less than 1 meters, 1-5 meters, 5-10 meters, 10-25 meters, 25-50 meters, and greater than 50 meters less than 1 meters, 1-5 meters, 5-10 meters, 10-25 meters, 25-50 meters, and greater than 50 meters.

III. ANALYSIS OF RESULTS

After combining the availability of positioning technologies and the requirements of the applications' categories, the low critical outdoor applications have the required technologies covered. High critical indoor applications also have a technology covered, even though the Bluetooth beacon network requires a heavy infrastructure which makes it not practical to implement nor cost-effective. On the other hand, high and medium critical outdoor applications don't have a reliable technology.

To overcome the technology gap that was highlighted in the previous section, there are currently several alternative solutions that are still not in commercial production [2, 3]. From the several available options, this study suggests few potential solutions that could be implemented in future designed smartphones. These solutions are: Differentially Corrected GPS which provides highly accurate positioning at the expense of high cost high power consuming hardware; Terrestrial Transmitters which provides highly accurate indoor and outdoor positioning at the expense of high cost hardware, and currently limitedly available coverage (pilot project only in Australia); and Joint utilization of Wireless Sensors Network (WSN) and Radio Frequency Identifier (RFID) which provide accurate (relatively less than the previous two suggestions) indoor positioning at low additional cost.

IV. CONCLUSION

After matching and assessing the results, low critical outdoor and high critical indoor applications were technologically covered; high and medium critical outdoor ones weren't fully resolved. Accordingly, this study suggested 3 potential solutions that could be implemented in future smartphones, such as integration of RTK GPS correction for outdoor high accuracy positioning, indoor and outdoor high accuracy positioning through adoption of terrestrial transmitters infrastructure, and integration of combined WSN-RFID for low-cost low power consumption indoor positioning.

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